

# The comparison of narrow and regular platform dental implants placed in posterior regions: A retrospective, longitudinal study

Comparison of narrow and regular implants

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## Abstract

**Aim:** The present study aimed to evaluate the clinical measurements and radiographic marginal bone loss of narrow and regular platform dental implants with the TiUnite surface placed in the posterior jaws.

**Material and Methods:** The study was designed as a retrospective, parallel, longitudinal pilot trial. Twenty-eight patients (mean age:  $48.34 \pm 6.06$ ) and 66 TiUnite surfaces bone level dental implants (Nobel Biocare Parallel Conical Connection) were included in the study. The implants were divided into two different groups according to the narrow platform implants (NPIs) ( $n=32$ ) and regular platform implants (RPIs) ( $n=26$ ). The mean implant lengths, plaque index (PI), gingival index (GI), periodontal pocket depth (PD), gingival recession (GR), keratinized gingival width (KGW) and bleeding on probing (BOP) values were recorded. Mean marginal bone level (MBL) values were evaluated, in which the distance between the bone-implant contact and the implant shoulder reference points was assessed on digital periapical radiographs via a software program (Mediadent Software). The Student's t-test was used for between-group comparison. Trial registration: NCT04572490. Retrospectively registered, (available at: <https://clinicaltrials.gov/ct2/show/NCT04572490>).

**Results:** The mean MBL value was  $0.84 \pm 0.81$  mm in the NPIs group and  $0.44 \pm 0.65$  mm in the RPIs group. Regarding the radiological evaluations, there was a statistically significant difference between the groups in the mean MBL ( $p < 0.05$ ).  $F(3) + 6.56$ ,  $p < 0.001$  and the GR value of 41% of the variance in the dependent variable predict mean MBL positively and significantly in the NPI group.

**Discussion:** Within the limitations, in this study group, narrow-platform TiUnite surface conical connection dental implants showed a higher rate of gingival recession and, consequently, marginal bone loss was observed at a higher rate in the long follow-up period.

## Keywords

Dental Implants; Alveolar Bone Loss; Periodontal Pocket; Peri-Implantitis; Narrow Platform

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## Introduction

The increasing use of dental implants as a treatment option for edentulous areas, the option of dental implants in different diameters, lengths, and designs, which can be applied in various clinical cases [1]. Many factors, such as the implant diameter, buccolingual thickness of the residual alveolar bone, the implant platform, the occlusion type, and the mesiodistal dimension for prosthetic restoration, are important in implant design and commercial brand selection [2].

In such cases, horizontal augmentation or narrow diameter implant placement is considered two different surgical techniques [3,4]. Al-Johany et al. have shown that the diameter was classified as narrow when the implant diameter was less than 3.75 mm; however, the definition of NPIs in the studies in the literature varies according to manufacturer [1]. The use of narrow platform implants (NPIs) to avoid bone augmentation is preferable, particularly in the posterior jaws, because of its high success rate and cost-effectiveness [5]. The narrow diameter of the implant leads to a decrease in the osseointegrated surface area; therefore, the possible complications increase depending on the mechanical stress on the screw and abutment parts of the implant [6]. Because of the direct connection between dental implants and alveolar bone and the absence of a periodontal ligament, repetitive and excessive mechanical stress on the implant may cause resorption of alveolar marginal bone [7]. Dittmer et al. have conducted static load tests with the same geometry setup and reported that the load-bearing capacity was higher in TiUnite surface implants than sandblasted, large grit, acid-etched (SLA) surface implants [8]. Song et al. have mentioned that the reduced implant diameter and the implant neck showed lower fatigue strength in terms of suprastructure failure compared to the standard diameter implant [9].

Albrektsson et al. have reported that a mean 2 mm peri-implant marginal bone loss (MBL) was acceptable in the first year of implant treatment, and then 0.2 mm MBL each year would generally be within physiological limits [10]. De Souza et al. concluded that there is no statistically significant difference in terms of radiographic MBL of narrow platform implants (NPIs) and regular platform implants (RPIs) placed in posterior regions [11]. Zweers et al. evaluated NPIs for implant-supported overdenture prostheses, and reported higher MBL compared to RPIs [4]. In addition, there was more alveolar bone loss in the molar region than implants placed in the premolar region; and there is no difference in terms of MBL in splinted or single implant-supported fixed prostheses [12,13].

The hypothesis of this study is that there is no difference with regards to MBL and prosthetic complications in NPI and RPI implants with TiUnite surface in implants placed in the posterior region. This study aimed to compare the long-term radiographically peri-implant MBL, clinical measurements, and prosthetic complications of NPIs and RPIs placed in posterior jaws after functional loading.

## Material and Methods

### Study Design

The study was designed as a retrospective, nonequivalent control group, parallel, two-year longitudinal pilot trial and evaluated implant-supported fixed prostheses placed in the posterior jaws

of patients who received implant treatment at the Faculty of Dentistry at Kütahya Health Sciences University between 2016 December and 2018 October. Non-Interventional Clinical Ethics Committee of Kütahya Health Sciences University approved the study (Decision No: 2019/07-4 Date: 27.06.2019) and it is registered at ClinicalTrials.gov ((NCT04572490) 01.10.2020). All data were collected between July 2019 and September 2019 and all patients signed informed consent.

### Inclusion criteria

Inclusion criteria were as follows: the presence of a dental implant treated with fixed prosthetic restoration placed in the posterior jaw, followed for at least one year after functional loading, no active periodontal disease, no history of penicillin allergy, no radiotherapy to the head and neck region, smoking less than ten cigarettes per day, no bone augmentation surgery before or during dental implant surgery, age >18, no mesial or distal additional crown restoration, no use of medications that affect bone metabolism, and no pregnancy or lactation.

### Exclusion criteria

The implants placed in the anterior region, immediate placing and loading, or augmented before or using a graft membrane with surgery were excluded from the study

### Patient Selection and Assignment

Fifteen male and 13 female patients and 66 dental implants were included in the study. This observational retrospective study was designed according to the STROBE Statement guidelines [14]. A study flow chart of this study was shown in Figure 1.

The assignment was performed according to the dental implant diameters to include cases in the NPI and RPI which are the test and control groups. All dental implants involved are the Nobel Biocare Parallel CC brand (Nobel Biocare, Gothenburg, Sweden) with a TiUnite surface, and it defined a regular diameter of 4.3 mm and narrow diameter of 3.75 mm. Dental implants were divided into two groups according to implant diameter, the NPI group comprised 3.75 mm diameter (NP, Ø= 3.75 mm) implants, and the RPI group comprised 4.3 mm diameter (RP, Ø= 4.3mm) implants (implant lengths: 10 mm-13 mm).

### Clinical Measurements

The clinical measurements were recorded during subsequent sessions using a periodontal probe that was calibrated in 1 mm increments. The clinical measurements were as follows: 1) plaque index (PI); 2) gingival index (GI); 3) probing depth (PD); 4) clinical attachment level (CAL); 5) bleeding on probing (BOP); 6) keratinized gingival width (KGW); 7) gingival recession (GR). The same researcher performed all clinical measurements. The calibration protocol was applied to the reliability of the measurements. PI, GI, PD, CAL, GR, KGW measurements were assessed in five patients and ten peri-implant values. The calibration was accepted when measurements were 90% similar. All clinical measurements were recorded for four sites (mesiobuccal, distobuccal, mid-buccal, mesiopalatal, midpalatal, and distopalatal) per peri-implant region. PD and PI measurements are reliable in peri-implantitis diagnosis.

Prosthetic complications of patients were also evaluated clinically. Veneer ceramic chipping, abutment screw loosening or fracture, implant fracture, loss of retention were recorded.

Radiographic Measurements

Studies have shown that periapical radiographs obtained using the parallel technique are reliable in detecting the MBL changes at different follow-ups. Digital periapical radiographs of the posterior region were obtained using a parallel method at follow-up sessions. MBL measurements were provided on periapical radiographs using a software program (Mediagent Software, The Dental Imaging Company, London, England). Ten radiographic measurements of MBL around the peri-implant were performed twice with an interval of 3 weeks, and the researcher’s calibration was accepted when the measurements were similar as %90. Measurements were performed separately from the mesial and distal parts and also the average of the two measurements. The reference points for assessment are the implant shoulder and the most apical end-point of the bone-implant contact point. The vertical distance between these two points is defined as MBL (Figure 2).

Primary and Secondary Outcome Variables

Mean MBL and prosthetic complications were assessed as the primary outcome variables. Also, clinical measurements such as PD, GR, and KGW and those related with mean MBL, were evaluated as secondary outcome measurements.

Surgical Treatment and Prosthetic Rehabilitation

All surgical treatments were performed with the same surgical protocol by the same surgeon. Antimicrobial prophylaxis with amoxicillin-clavulanate (2 x 1000 mg per day) was started one day before surgery. Local anesthesia was applied to the surgical site, and the full-thickness flap was raised. Dental implants were placed with a 35 Ncm<sup>2</sup> insertion torque. All dental implants were placed crestally and the flap was closed primarily; a two-stage surgical technique was applied. As a postoperative recommendation, the patients have been prescribed amoxicillin-clavulanate 1000 mg per day for seven days. Diclofenac potassium 50 mg as an analgesic and 0.012% chlorhexidine mouthwash were recommended for all patients until the sutures were removed one week later. All prosthetic rehabilitation was planned as veneer, and cemented fixed-suprastructures, and was delivered to the patient.

Statistical analysis

Data analysis was performed using a software program (SPSS Statistics for Windows, version 20.0, Chicago, IL, USA). All clinical and radiological measurements showed a normal distribution in the study; Student’s t-test was used to compare NPIs and RPIs groups . Descriptive data presented as percentages, and clinical and radiological data presented as mean±SD. A p-value of less than 0.05 was accepted as statistically significant. De Souza et al reported that the sample was determined as 22 for each group to detect MBL with 80% power and α = 0.05. [11] According to the results, the required number of implants was determined with power analysis (G Power, Brunsbüttel, Germany) to be 30 for each group. In order to evaluate the effect on mean MBL, a multivariate regression analysis test was applied for PD, GR and KGW independent variables.

Results

Demographic Data

Twenty-eight patients (mean age: 48.34 ± 6.06 years) with 66 TiUnite surfaces dental were included in the study. The dental

Table 1. Demographic data related to implant and patient characteristics

	NPI (n=32)	RPI (n=26)
Age (mean±SD)	46.97±6.98	50.86±5.28
Dental Implant localizations		
Right Maxilla	6	3
Left Maxilla	7	8
Right Mandibula	9	4
Left Mandibula	10	11
Implant Length mm (mean±SD)	10.33±1.19 (8.5-13.0 mm)	10.38±1.29mm (8.5-13.0 mm)
Follow-up year (mean±SD) (min-max)	2.39 ± 0.62 (1.3 – 3.2)	2.10±0.63 (1.3- 3.2)
Number of implants exposed to smoking	5 (15.62%)	12 (46.15%)
History of Periodontitis (implant number)	2 (6.25%)	2 (7.69%)
Single Crown (%)	17 (53.12%)	14(53.84%)
Splinted Restoration	15 (46.87%)	12(46.15%)
Occlusal Trauma	5 (15.62%)	3 (11.53%)

NPIs: Narrow Platform Implants; RPIs: Regular Platform Implants

Table 2. Comparison of radiographic and peri-implant clinical measurements between the NPIs and RPIs

	NPI (n=32) (mean±SD)	RPI (n=26) (mean±SD)	p- values
Mesial-MBL	0.80± 0.85	0.40±0.75	0.070
Distal-MBL	0.87±0.84	0.48±0.68	0.055
Mean-MBL	0.84±0.81	0.44±0.65	0.046*
PI	0.94±0.59	1.01 ± 0.96	0.727
GI	0.98±0.76	0.96±0.71	0.881
PD	2.26±0.48	2.27±0.57	0.972
GR	0.09±0.37	0.02±0.13	0.363
KGW	1.91±1.39	2.52±1.51	0.121
BOP	58.33% ±38.68%	56.08%±45.25%	0.842

NPIs: Narrow Platform Implants; RPIs: Regular Platform Implants; MBL: Marginal Bone Loss; PI: Plaque Index; GI: Gingival Index; PD: Periodontal Pocket Depth; GR: Gingival Recession; KGW: Keratinized Gingival Width; BOP: Bleeding on Probing. Student-T Test was used for statistical analysis. Statistical significance was p <0.05.

Table 3. Multiple regression analysis of mean marginal bone loss and related clinical factors

		B	SE	β	t	p- value
NPIs*	PD	0.83	0.247	0.05	0.336	0.74
	GR	1.38	0.316	0.63	4.35	0.00
	KGW	-0.41	0.087	-0.7	-0.47	0.64
RPIs**	PD	0.05	0.25	0.047	0.214	0.83
	GR	-0.016	1.05	-0.003	-0.015	0.98
	KGW	0.04	0.095	0.094	0.429	0.67

\*F=6.536, R=0.642 R<sup>2</sup>=0.412; \*\* F=0.102 R=0.117 R<sup>2</sup>=0.014 B: Partial regression coefficient; β: Standart regression coefficient; SE: Standart error

implant survival rate was 100%. The mean follow-up time was 2.39 ± 0.62 years in the NPI group and 2.10±0.63 years in the RPI group. The mean length of the implants was found 10.33±1.19 mm in NPI group and 10.38±1.29 mm in RPI group. Dental implant localizations, history of periodontitis, smoking and single or splinted crowns values are shown in Table 1.

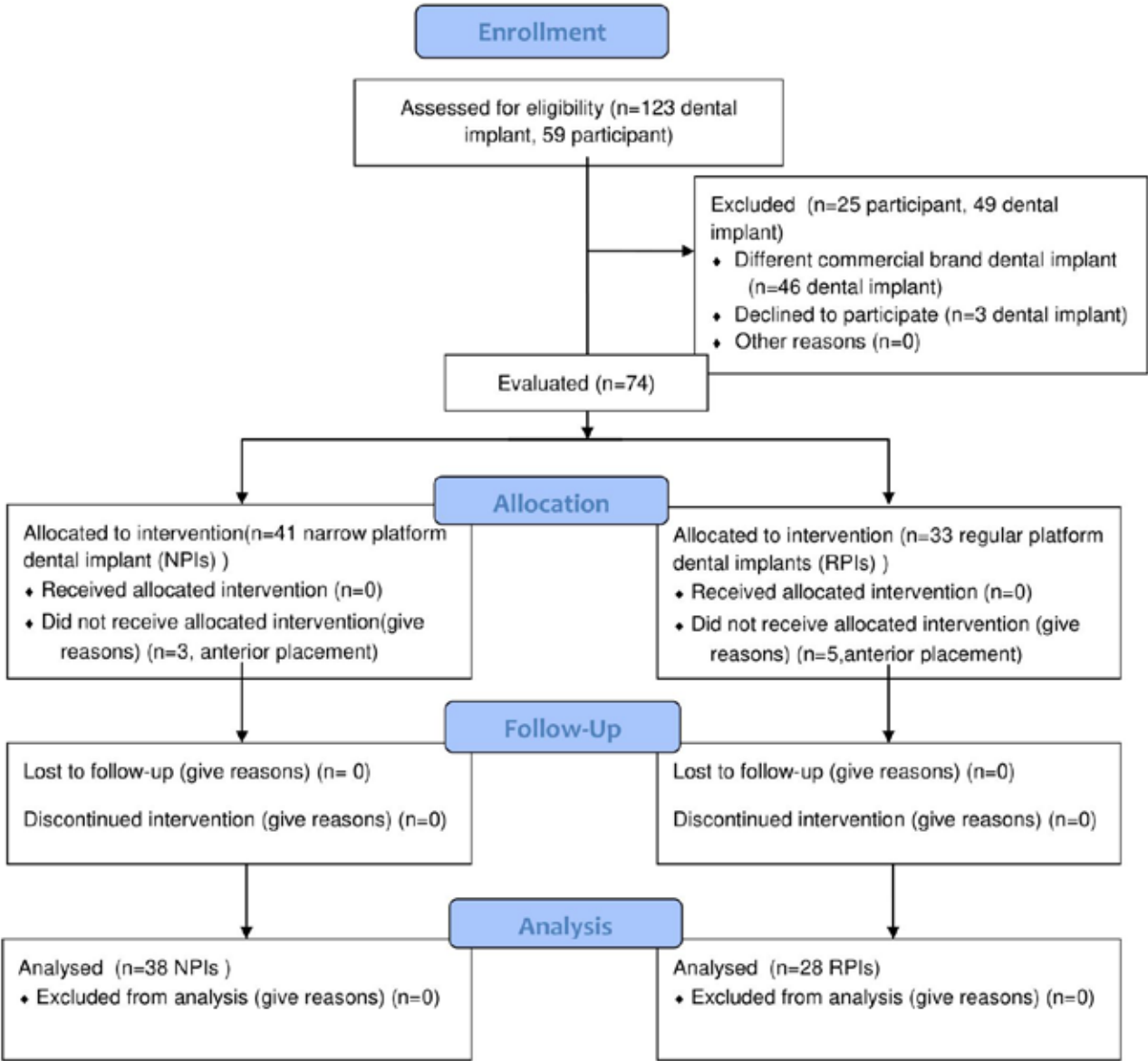


Figure 1. Study flow chart



Figure 2. Radiographic images of NDI at (a) baseline, (b) immediately after loading (c) 3 years after loading.

Primary Outcomes

The mean MBL value was  $0.84 \pm 0.81$  mm in the NPIs group and  $0.44 \pm 0.65$  mm in the RPIs group. Regarding the radiological evaluations, there was a statistically significant difference between the groups in the mean MBL ( $p < 0.05$ ) (Table 2). When prosthetic complications were examined, abutment screw loosening occurred in solely one RPIs single-crown fixed prosthetic restoration.

Secondary Outcomes

There was no statistically significant difference between the NPIs and RPIs groups in terms of all clinical measurements. KGW values were  $2.46 \pm 1.62$  mm and  $2.60 \pm 1.5$  mm in the NPIs and RPIs groups, respectively. PD levels were  $2.25 \pm 0.57$  mm in the NPIs group and  $2.29 \pm 0.48$  mm in the RPIs, and the GR values were  $0.08 \pm 0.35$  mm in the NPIs group and  $0.02 \pm 0.12$  mm in the RPIs group, respectively (Table 2).

As a result of the multivariate regression analysis, a significant regression model was obtained in the NPI group, but no significant model was obtained in the RPI group.  $F(3) + 6.56$ ,  $p < 0.001$  and the GR value of 41% of the variance in the dependent variable predict the mean MBL positively and significantly in the NPI group. As a result of the analysis, it was found that the effect of PD and KGW on mean MBL was not found in both study groups (Table 3).

## Discussion

Recently, studies comparing the placed NPIs and RPIs in the posterior region on variable patient populations have increased. [11,15] The hypothesis that “there is no difference with regards to MBL and prosthetic complications in NPI and RPI implants with TiUnite surface in implants placed in the posterior region” is rejected for MBL and prosthetic complications in this study population. This study has shown that radiographically MBL changes were increased in the NPI group comparing to the RPI group in the long-term, and gingival recession was related to increased mean MBL.

Galindo-Moreno et al. have concluded that MBL rates were significantly affected by connection type, bone substratum, and smoking. [16] However, Hingsammer et al. reported that age, gender, insertion torque, implant surface area, location, position, bone quality, and insertion torque did not influence peri-implant bone loss after one year of loading for short-splinted dental implants [17]. The mean peri-implant MBL would be higher with narrow implants due to decreased implant surface area exposed to excessive occlusal force and the accumulation of mechanical stress on the implant shoulder [7]. However, De Souza et al. have mentioned that no statistically significant difference was found in terms of MBL in SLA surface NPIs and RPIs in posterior jaws in a randomized controlled clinical study [11]. Grandi et al. have shown that one-year follow-up clinical and radiological evaluations were performed after splinted fixed NPIs supported fixed prosthetic restorations in the posterior mandible, and the mean MBL was reported 0.48 mm in the first year [15]. The mean 10-year follow-up of NPIs placed in the posterior region revealed that the mesial MBL was 1.16 mm, and the distal MBL was 1.21 mm; 1.10 mm in single crowns and 1.22 mm in splinted restorations. Also, it has been mentioned that SLA surface implants placed in the premolar region to NPIs have higher MBL than those placed in the molar region [18]. Hingsammer et al. reported that factors affecting MBL in short and NPIs were evaluated. Thus, the MBL around short implants measured  $0.71 \text{ mm} \pm 0.74 \text{ mm}$  and has been found to have a strong correlation with the calculated crown-to-implant ratio [17]. In our study, the lengths of the dental implants were recorded, but crown-implant ratios were not evaluated. The assessment of the effect of dental implants on crown-to-implant ratio and MBL by calibrating on radiographs may be necessary for clarifying the factors that will affect MBL in NPIs. Shi et al. have shown that the risk of prosthetic complications with SLA surface NPIs was significantly higher than with splinted restorations of single crowns [18]. In a review, the most common complications in single crown restorations are loss of retention, screw loosening, or veneer chipping [19]. De Souza et al. reported that two RPIs and one NPI had screw loosening, and

one RPI had veneer chipping [11]. Also, Al-Aali et al. evaluated technical complications on NPIs splinted and a single crown fixed prosthetic restoration, they reported that significantly more complications were observed in single crowns [12]. Controversial results in the studies may be due to different implant systems, different abutment torque application force, different implant placement techniques, the bone structure of the implant placing region, or the experience of the dentist who performed the prosthetic restoration. In this study, abutment screw loosening was found solely in one single-crown RPI implant placed in the maxilla.

The studies have reported that smoking is a risk factor for peri-implantitis and causes a higher rate of both periodontal and peri-implant destruction [20, 21]. Alasqah et al. showed that MBL was higher in smokers, however, no differences were found between the NPI and RPI groups in a 3-year retrospective study of SLA surface NPIs and RPIs [22]. Arisan et al. found that 81 Friadent Plus surface implants with 3.4 diameters and sandblasted, large-grit, acid-etched (SLA) surface implants were evaluated clinically and radiographically in a 5-year follow-up study; in terms of MBL, there was more bone destruction in the posterior jaws compared to the anterior region and in smokers compared to non-smokers [23]. In our study, although there were a higher number of implants exposed to smoke in the RPI group, a lower rate of MBL was confirmed in the RPI group than the NPI group.

Gingival recession was evaluated in a single study comparing NPIs and RPIs. Ghazal et al. reported that there was no statistically significant difference regarding gingival recession between the NPI and RPI groups [24]. In this study, there were no statistically significant differences between the groups in GR values, however, in regression analysis, an increased gingival recession affected mean MBL in NPI groups.

De Souza et al. reported that MBL was  $0.58 \pm 0.39 \text{ mm}$  for NPIs and  $0.53 \pm 0.46 \text{ mm}$  for RPIs, however, there is no information on implant placement in bone level crestally or subcrestally [11]. In a long-term study of subcrestally and crestally placed dental implants, the mean MBL value was  $1.2 \pm 0.2 \text{ mm}$  for the 2 mm subcrestally placed implant and  $1.4 \pm 0.2 \text{ mm}$  for the crestally placed implant [25]. In this study, all dental implants were placed crestally according to the manufacturer's recommendations.

One of the limitations of this study is the evaluation of splinted and single crowns in a pool. The present study did not evaluate whether the opposite occlusion was tooth-supported or removable prosthesis-supported. Since this study was evaluated prospectively, however, patient-related operational data could not be assessed. An important limitation in this study is that the implant placement area, the amount of buccal alveolar bone remaining after implant placement, and the biological width, which are factors that will affect the peri-implant MBL, are not evaluated.

**Conclusion:** In terms of clinical peri-implant measurements and prosthetic complications, there was significant difference was found between the NPI and RPI groups at the 2-year follow-up. Within the limitations, in this study group, narrow-platform implants showed a higher rate of gingival recession and, consequently, marginal bone loss was observed at a higher rate in the long follow-up period. Studies with a larger data set are needed.

**Scientific Responsibility Statement**

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

**Animal and human rights statement**

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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**Conflict of interest**

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